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Ikuta et al.

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(54) **DUST COLLECTING DEVICE AND IMPACT TOOL**

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B25D 17/22 (2006.01)
(Continued)

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CPC ***B25D 17/22*** (2013.01); ***B23Q 11/0046*** (2013.01); ***B25D 17/04*** (2013.01); *Y02P 70/171* (2015.11)

(58) **Field of Classification Search**
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USPC 173/198, 217, 171
See application file for complete search history.

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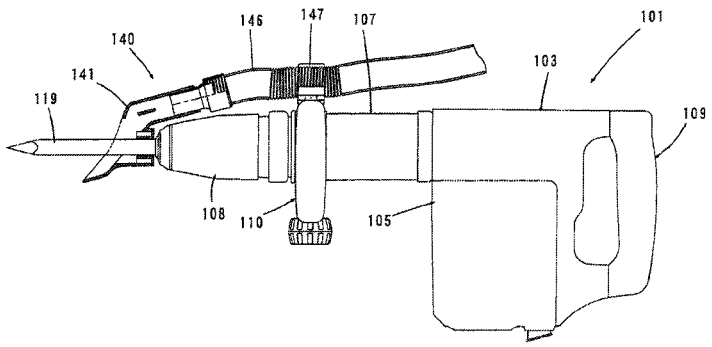
(74) *Attorney, Agent, or Firm* — Oliff PLC

(57) **ABSTRACT**

In a dust collection device that collects dust particles that an impact tool generates, disclosed is a feature that can accommodate the lengths of tool bits that are mounted to the impact tool when a machining operation is executed by exchanging tool bits of different lengths. The dust collection device collects dust that the impact tool generates and is attached to said impact tool that, in the lengthwise direction, linearly operates the tool bit mounted to the end region of a tool body. The dust collection device has a dust intake port that sucks dust, and said dust intake port can be repositioned in the lengthwise direction of the tool bit in accordance with the length in the lengthwise direction of said tool bit.

7 Claims, 10 Drawing Sheets



(51) **Int. Cl.**
B25D 17/04 (2006.01)
B23Q 11/00 (2006.01)

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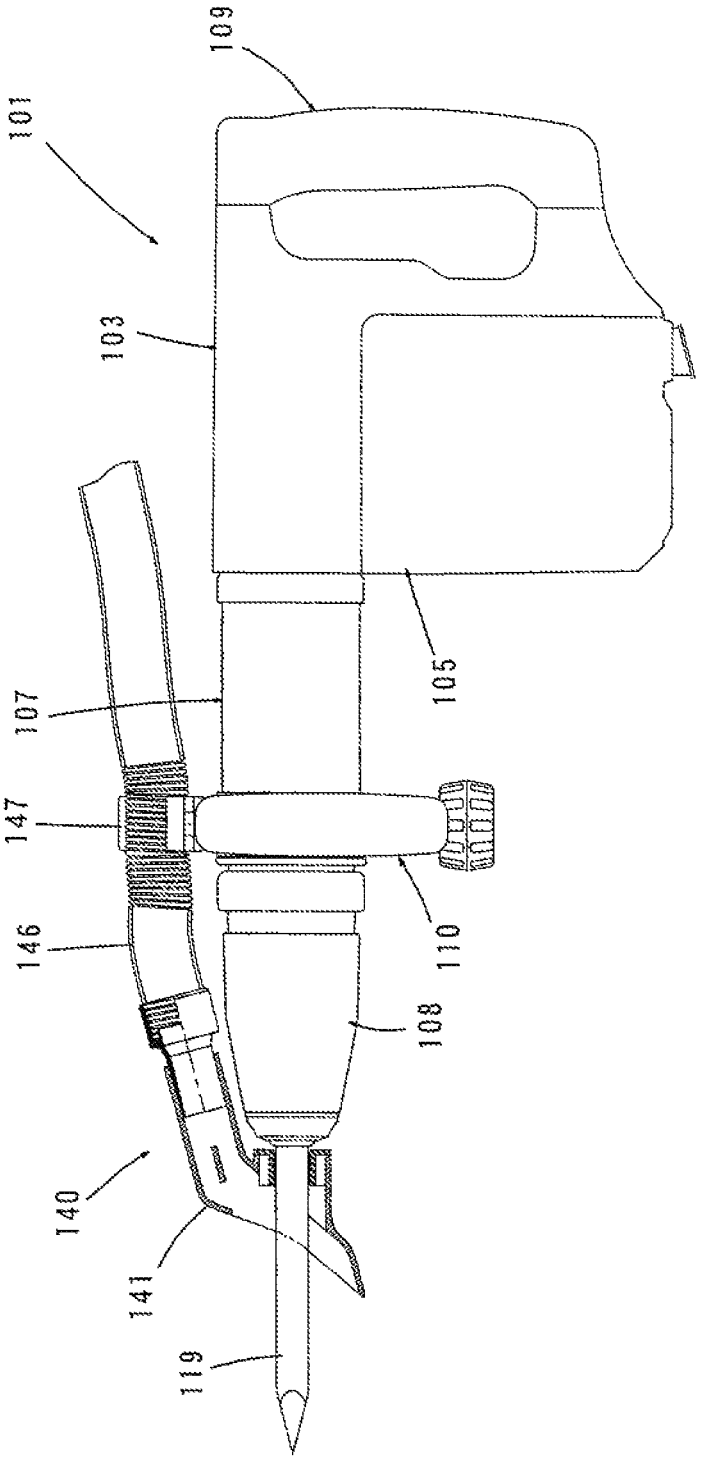
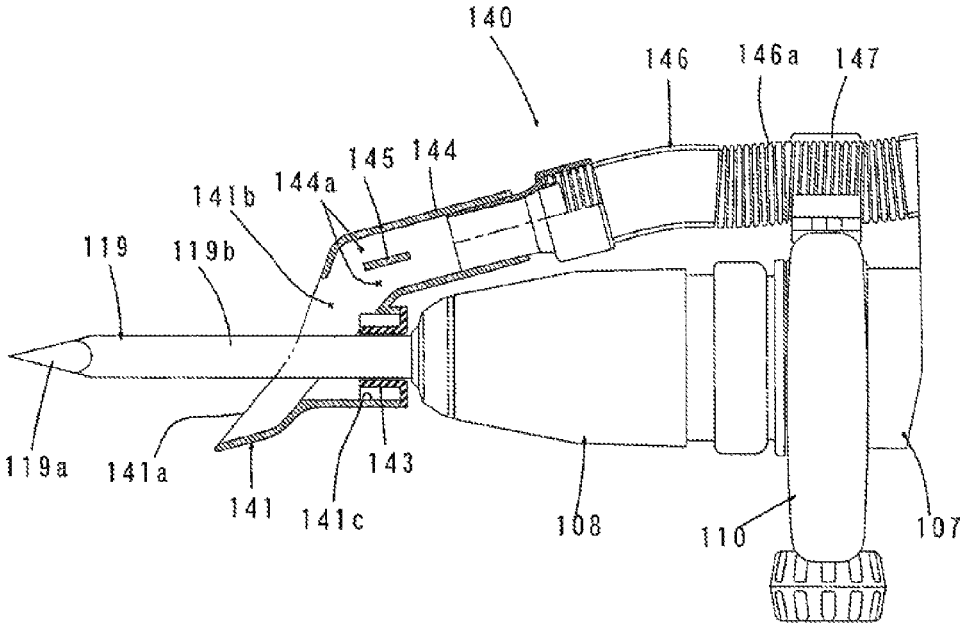


FIG. 1

FIG. 2


140
146
146a
147
145
144
144a
141b
119
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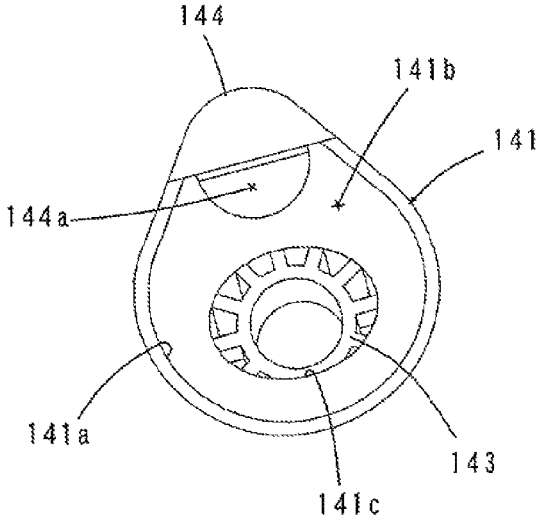
119a
141a
141
141c
143
108
110
107

FIG. 3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141b
141
144a
141a
143
141c

FIG. 4

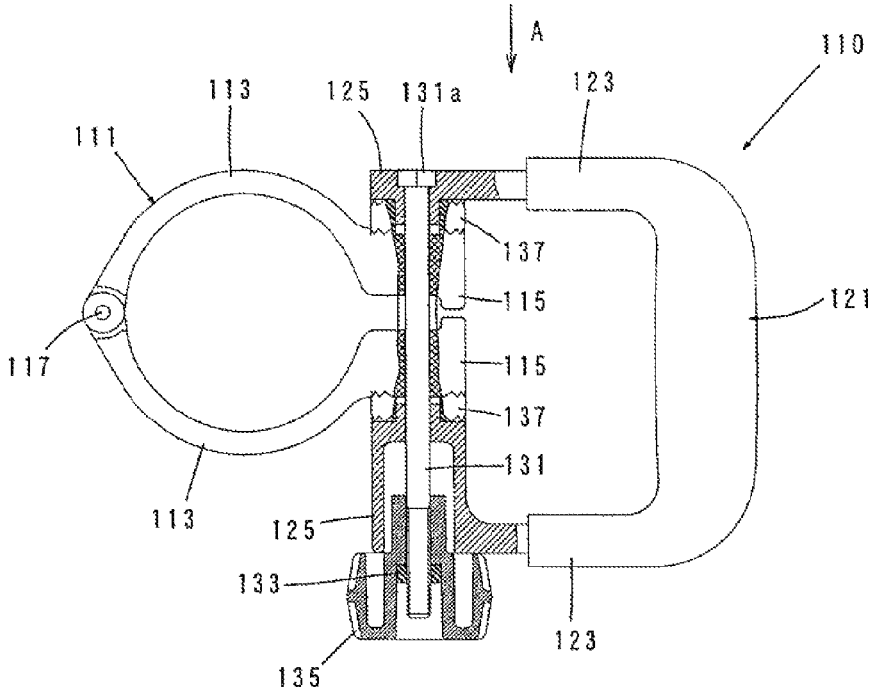

A
110
113
125
131a
123
111
137
115
121
117
115
137
131
113
125
133
123
135

FIG. 5

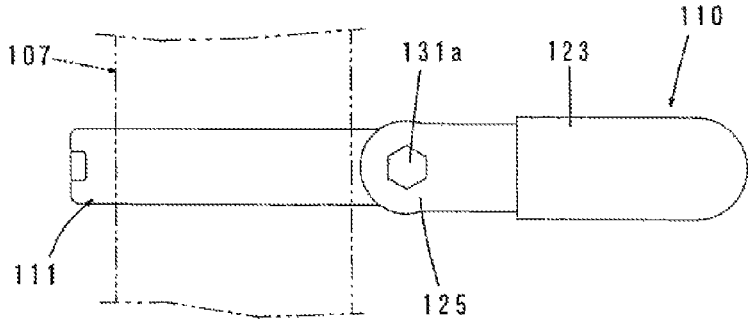

110
107
131a
123
111
125

FIG. 6

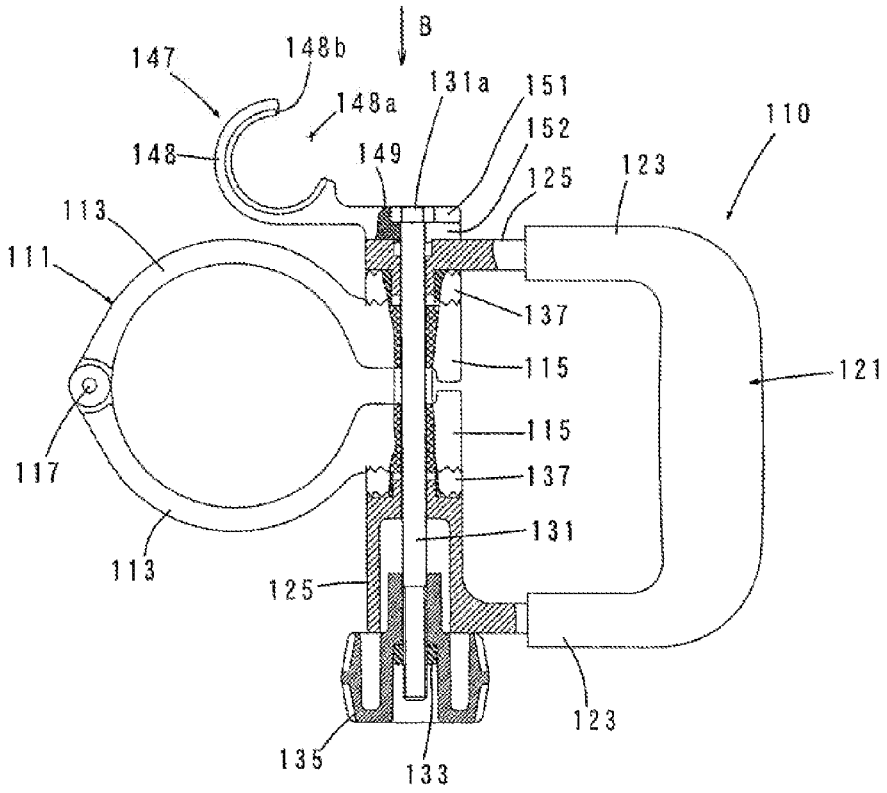

B
147
148b
148a
148
149
131a
151
152
125
123
110
113
111
137
115
121
115
117
137
131
113
125
123
135
133

FIG. 7

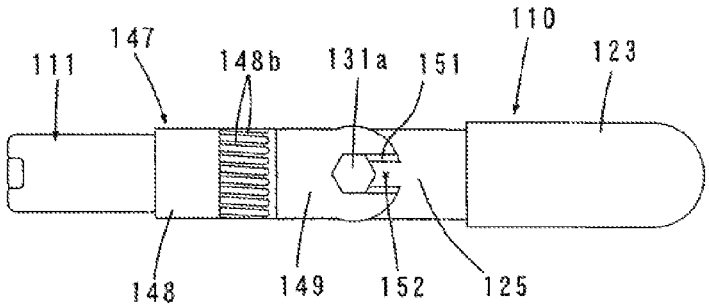

110
147
111
148b
131a
151
123
148
149
152
125

FIG. 8

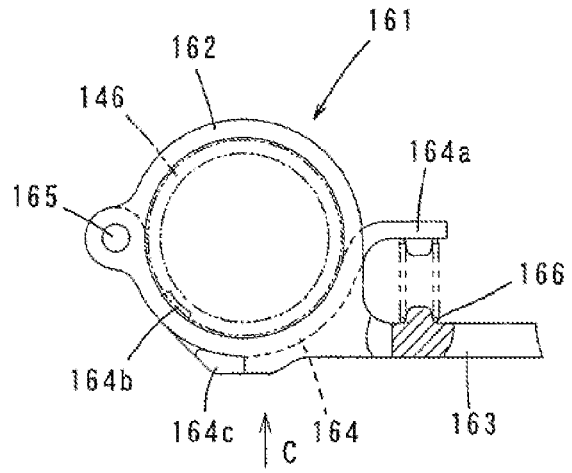


FIG. 9

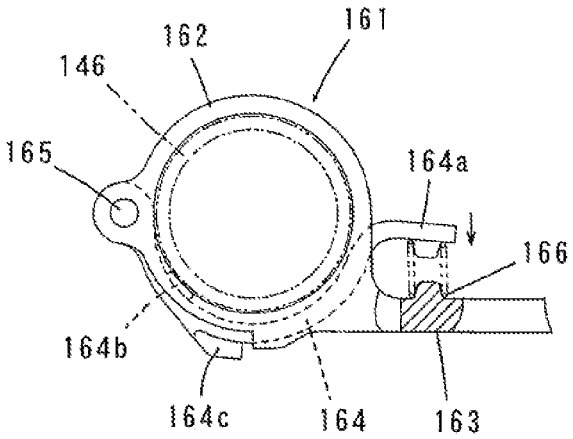
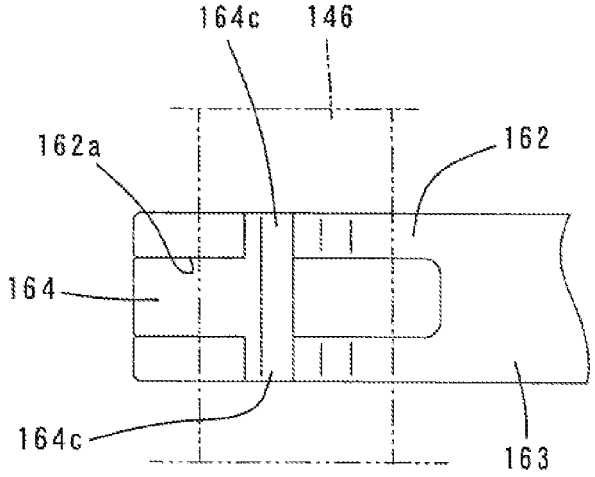


FIG. 10



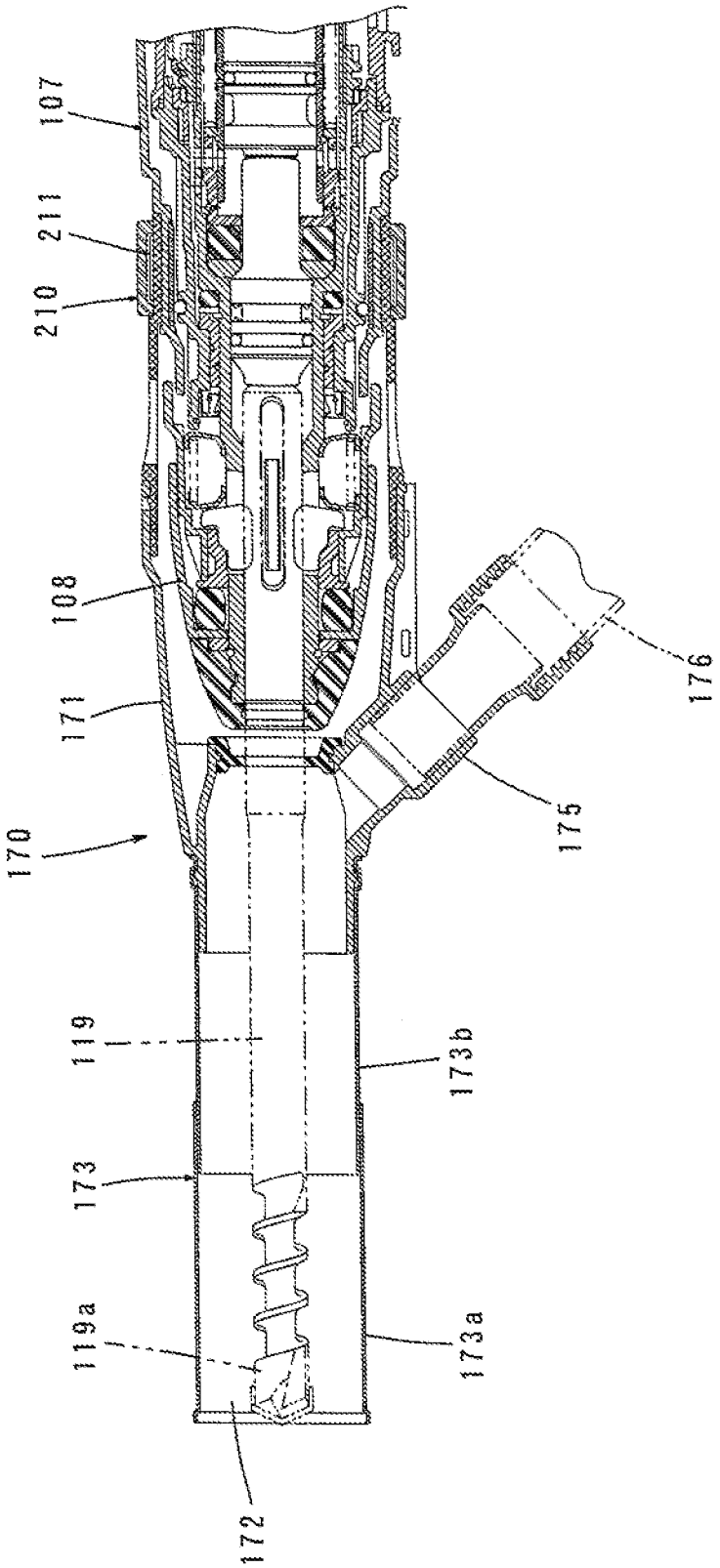


FIG. 11

FIG. 12

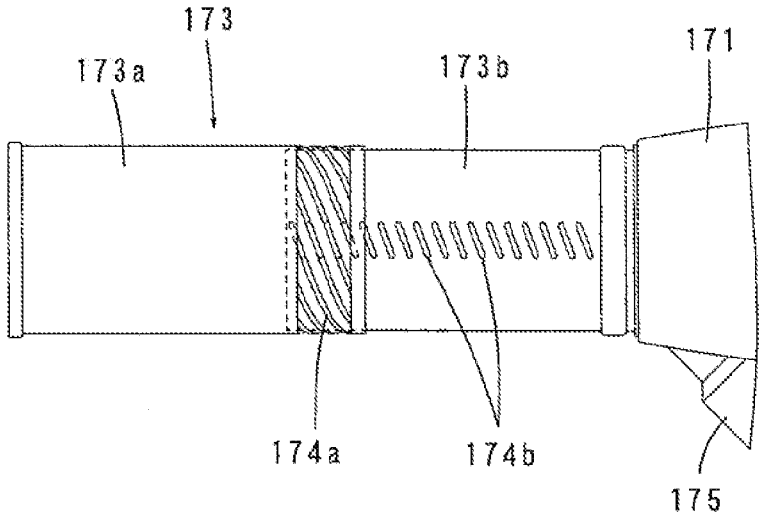
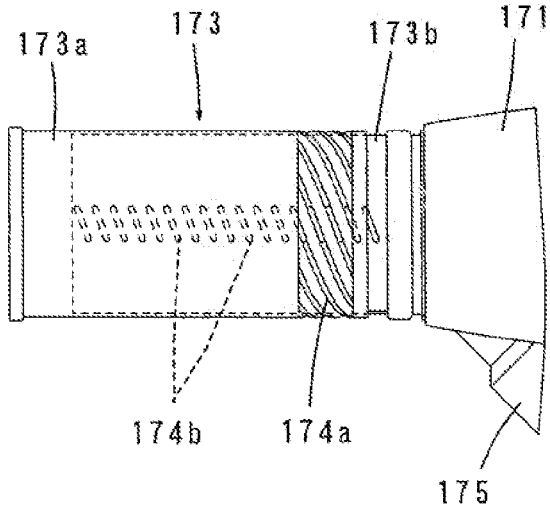

173
173a
173b
171
174a
174b
175

FIG. 13


173a
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173b
171
174b
174a
175

FIG. 14

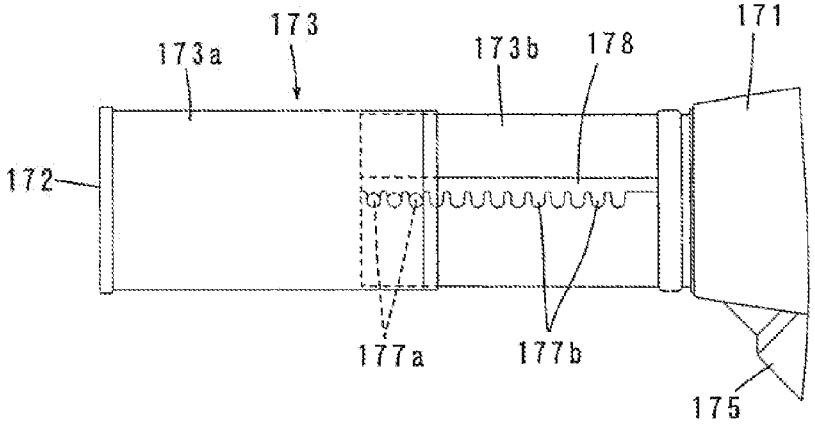


FIG. 15

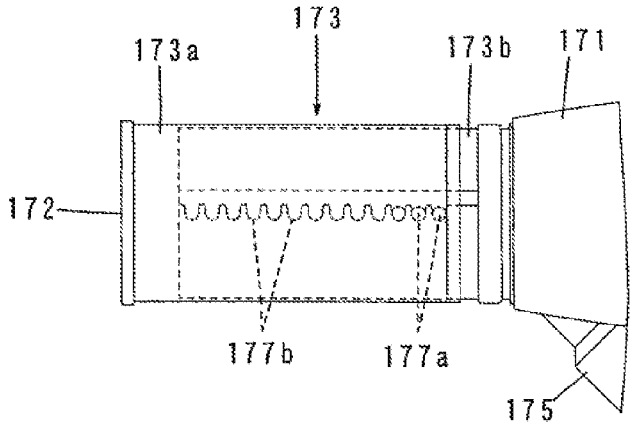


FIG. 16

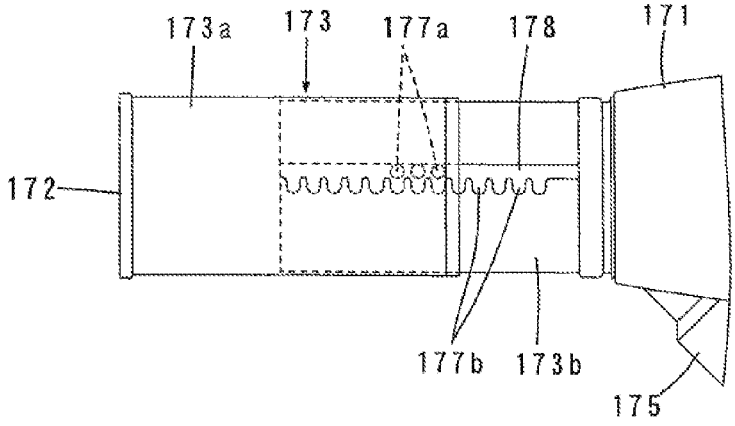


FIG. 17

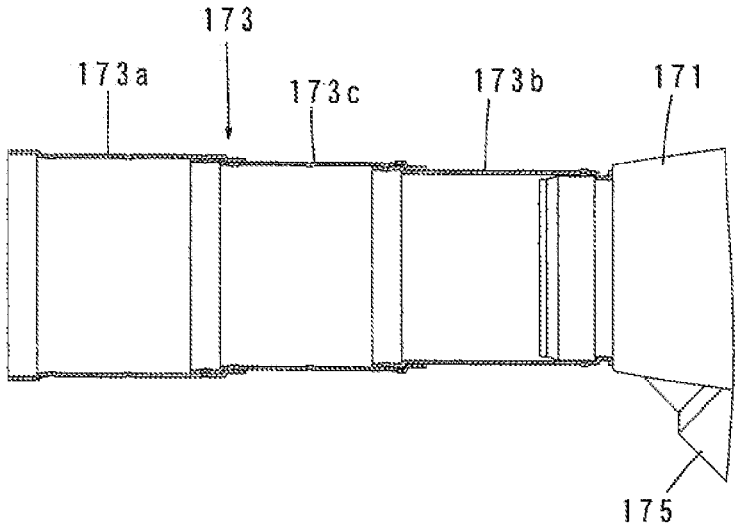
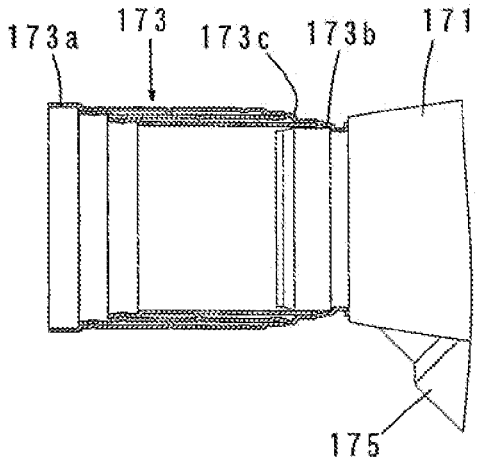


FIG. 18



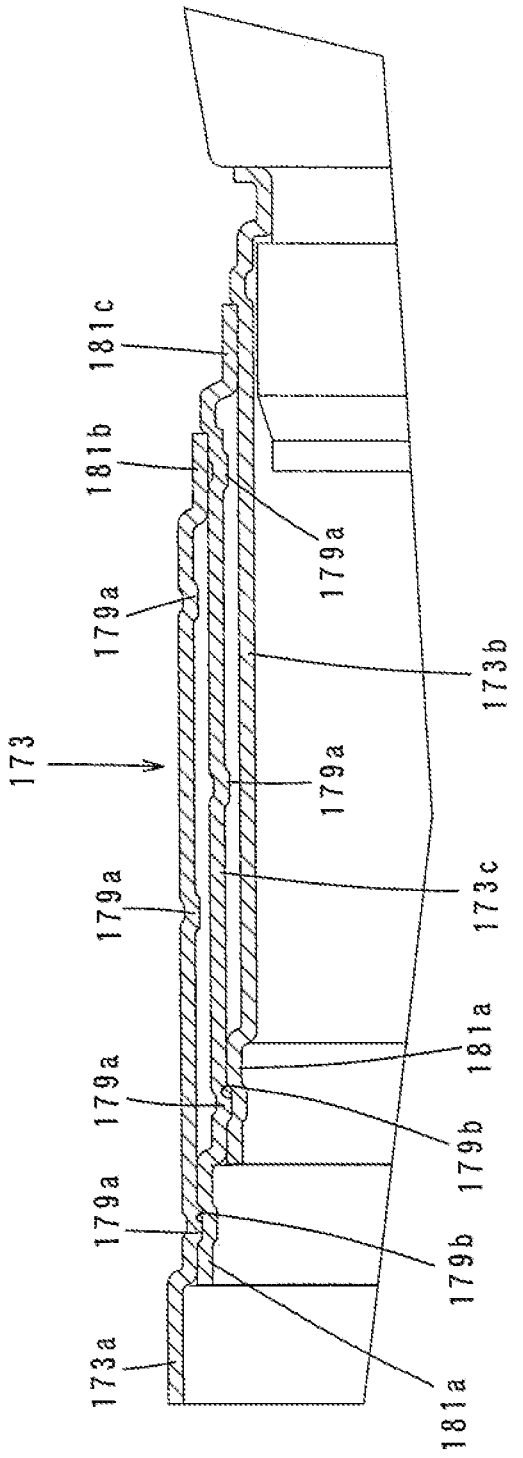

181c
181b
179a
179a
173b
173
179a
179a
173c
181a
179a
179b
179a
179b
173a
181a

FIG. 19

DUST COLLECTING DEVICE AND IMPACT TOOL

FIELD OF THE INVENTION

The invention relates to a dust collecting device for collecting dust generated by an impact tool, and an impact tool having the dust collecting device.

BACKGROUND OF THE INVENTION

In an impact tool which performs a hammering operation or a hammer drill operation by a tool bit on a workpiece such as concrete, dust is generated during operation. Therefore, some conventional impact tools are provided with a dust collecting device for collecting dust generated during operation. For example, Japanese non-examined laid-open Patent Publication No. 2007-303271 discloses a dust collecting device having a cylindrical hood which is arranged to surround a tool bit. In this dust collecting device, dust generated by operation is sucked up through a front end opening of the hood and collected via a pipe and a dust transfer passage formed within the impact tool body.

The above-described known dust collecting device is configured such that the front end of the hood is fixed in position with respect to the tool body. Therefore, for example, when a longer tool bit than usual is used, the distance between the hood front end and a dust generation area is increased, so that the dust collecting efficiency is reduced.

DISCLOSURE OF THE INVENTION

Problems to be Solved by the Invention

It is, accordingly, an object of the present invention to provide a technique for accommodating different lengths of tool bits which are mounted to an impact tool when replacing the tool bits having different lengths, in a dust collecting device for collecting dust generated by the impact tool.

Means for Solving the Problem

In order to solve the above-described problem, in a preferred embodiment according to the present invention, a dust collecting device is provided which is attached to an impact tool and collects dust generated by the impact tool. In the impact tool, a tool bit coupled to a front end region of a tool body is caused to rectilinearly move in an axial direction of the tool bit. The dust collecting device has a dust suction port through which dust is sucked up, and the dust suction port can be adjusted in position in the axial direction of the tool bit according to the length of the tool bit coupled to the tool body. The manner in which the dust suction port "can be adjusted in position in the axial direction" in this invention refers to the manner in which the dust suction port can be moved in the axial direction and fixed in that position.

In the dust collecting device according to this invention, the position of the dust suction port can be adjusted according to the length of the tool bit which is selectively coupled to the tool body. Therefore, the dust suction port can be adequately positioned with respect to the tip of the tool bit to be used, and dust generated by operation can be efficiently collected. Further, it is not necessary to prepare a plurality of dust collecting devices so as to accommodate tool bits of different lengths.

According to a further embodiment of this invention, the dust collecting device can be attached to the tool body and includes a dust collecting part having the dust suction port at its front end, and a dust transfer part which is connected to the dust collecting part in order to transfer dust downstream from the dust suction port. The position of the dust suction port can be adjusted in the axial direction of the tool bit by changing a mounting position of the dust transfer part with respect to the tool body. The manner of "changing a mounting position of the dust transfer part with respect to the tool body" in this invention suitably includes the manner of providing one mounting area for mounting the dust transfer part in a fixed position of the tool body and changing the mounting position of the dust transfer part with respect to the mounting area, and the manner of providing a plurality of mounting areas on the tool body and changing the mounting position of the dust transfer part with respect to the mounting areas.

According to this invention, by changing the mounting position of the dust transfer part with respect to the tool body, the front end of the dust collecting part or the dust suction port can be adequately positioned with respect to the tip of the tool bit to be used.

According to a further embodiment of this invention, the dust transfer part is formed by a dust collecting hose which extends in the axial direction of the tool bit and a bellows-like part is formed at least in part of the dust collecting hose. The dust collecting device further includes a hose holding part which can be mounted to the tool body and engaged with the bellows-like part so as to hold the dust collecting hose on the tool body. Further, the position of the dust suction port can be adjusted by changing an engagement position of the bellows-like part in the axial direction with respect to the hose holding part. The manner of being "engaged with the bellows-like part" in this invention typically represents the manner in which one or more projections are inserted in a valley of the bellows-like part.

According to this invention, the position of the dust suction port can be adjusted by changing the engagement position of the bellows-like part of the dust collecting hose with respect to the hose holding part mounted on the tool body.

According to a further embodiment of this invention, the hose holding part includes an annular member through which the dust collecting hose is loosely inserted, an engagement member which is formed on the annular member and can be engaged with the bellows-like part, and a biasing member which constantly biases the engagement member in a direction in which the engagement member is engaged with the bellows-like part. Further, the engagement member can be moved in a radial direction of the annular member between a position of engagement with the bellows-like part and a position of disengagement from the bellows-like part.

According to this invention, the position of the dust suction port can be adjusted with respect to the tool bit by moving the engagement member to be disengaged from the bellows-like part and then moving the dust collecting hose in the axial direction. Once the position of the dust suction port is adjusted, engagement between the engagement member and the bellows-like part is maintained by the biasing member. Therefore, there exists no risk that the position of the dust suction port is unintentionally changed due to vibration caused by the operation.

According to a further embodiment of this invention, the dust collecting device has a bit covering which is arranged to surround the tool bit and has the dust suction port formed at its front end. The bit covering is formed by a plurality of cylindrical members which are fitted one on the other and can be moved relative to each other in the axial direction of the tool bit, and the position of the dust suction port can be adjusted by relative movement of the cylindrical members.

According to this invention, the position of the dust suction port can be easily adjusted by moving the cylindrical members fitted one on the other, with respect to each other in the axial direction.

According to a further embodiment of this invention, a female thread is formed in one of the cylindrical members and an engagement projection is formed on the other and engages with the female thread, and when turned relative to each other in the circumferential direction, the cylindrical members can be moved relative to each other in the axial direction by engagement between the female thread and the engagement projection.

According to this invention, stepless position adjustment can be realized by using the threads.

According to a further embodiment of this invention, the cylindrical members can be moved relative to each other in the axial direction and the circumferential direction, and one of the cylindrical members has a recess and the other has a projection which can be engaged with and disengaged from the recess by relative movement of the cylindrical members in the circumferential direction. Further, at least one of the recess and the projection is arranged in plurality in the axial direction of the cylindrical members.

Vibration is generated by operation of an impact tool mainly in the axial direction of the tool bit. According to this invention, with the construction in which the projection and the recess are engaged and disengaged by moving the cylindrical members relative to each other in the circumferential direction, the dust collecting device is less subject to the vibration, so that engagement between the recess and the projection can be maintained.

According to a further embodiment of this invention, the cylindrical members can be telescopically slid with respect to each other in the axial direction, and a projection is formed on one of a sliding inner surface of one cylindrical member and a sliding outer surface of the other adjacent cylindrical member, and a recess is formed in the other of the sliding inner surface and the sliding outer surface and can be engaged with and disengaged from the projection. The projection and the recess are engaged and disengaged by elastic deformation of the cylindrical members.

According to this invention, with the construction in which the dust collecting device is operated only in the axial direction and the projection and the recess are engaged and disengaged by elastic deformation, the dust collecting device is easy to operate.

According to a further embodiment of this invention, the impact tool can be provided with the dust collecting device which can be attached to the tool body and in which the position of the dust suction port can be adjusted according to the length of the tool bit to be used for operation.

Effect of the Invention

According to this invention, a dust collecting device for collecting dust generated by an impact tool is capable of accommodating different lengths of tool bits which are coupled to the impact tool when replacing the tool bits having different lengths.

Other objects, features and advantages of the present invention will be readily understood after reading the following detailed description together with the accompanying drawings and the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an external view showing an entire electric hammer with a dust collecting device according to a first embodiment of the present invention.

FIG. **2** is a sectional view showing the entire structure of the dust collecting device.

FIG. **3** is a front view showing the configuration of a front end of a dust collecting hood.

FIG. **4** is a partially sectional view showing the entire structure of a side handle.

FIG. **5** is a view taken from the direction of arrow A in FIG. **4**.

FIG. **6** is a partially sectional view showing a structure of mounting the dust collecting device to the side handle.

FIG. **7** is a view in the direction of arrow B in FIG. **6**.

FIG. **8** is a front view showing a hose holder of a dust collecting device according to a second embodiment of the present invention, when the dust collecting hose is locked against movement.

FIG. **9** is a front view also showing the hose holder when the dust collecting hose is unlocked.

FIG. **10** is a view in the direction of arrow C in FIG. **8**.

FIG. **11** is a sectional view showing a dust collecting device according to a third embodiment of the present invention.

FIG. **12** is an external view showing a telescopic dust collecting hood in a fully extended position.

FIG. **13** is an external view showing the telescopic dust collecting hood in a fully retracted position.

FIG. **14** is an external view showing a modification to the telescopic dust collecting hood according to the third embodiment, in a fully extended position.

FIG. **15** is an external view also showing the modification of the telescopic dust collecting hood in a fully retracted position.

FIG. **16** is an external view also showing the modification of the telescopic dust collecting hood in a position in which it is allowed to be extended and retracted.

FIG. **17** is a sectional view showing a second modification to the telescopic dust collecting hood according to the third embodiment, in a fully extended position.

FIG. **18** is a sectional view also showing the second modification of the telescopic dust collecting hood in a fully retracted position.

FIG. **19** is an enlarged partial view of FIG. **18**.

REPRESENTATIVE EMBODIMENT OF THE INVENTION

Each of the additional features and method steps disclosed above and below may be utilized separately or in conjunction with other features and method steps to manufacture and use improved dust collecting devices and impact tools and methods for using them and devices utilized therein. Representative examples of the present invention, which examples utilized many of these additional features and method steps in conjunction, is now described in detail with reference to the drawings. This detailed description is merely intended to teach a person skilled in the art further details for practicing preferred aspects of the present teachings and is not intended to limit the scope of the invention. Only the claims define the scope of the claimed invention. Therefore, combinations of features and steps disclosed within the following detailed description may not be necessary to practice the invention in the broadest sense, and are instead taught merely to particularly describe some representative examples of the invention, which detailed description will now be given with reference to the accompanying drawings.

(First Embodiment of the Invention)

A dust collecting device according to a first embodiment of the present invention is now described with reference to FIGS. **1** to **7**. This embodiment is explained as being applied

to an electric hammer as a representative example of an impact tool. FIG. **1** shows an electric hammer **101** having an auxiliary handle in the form of a side handle **110** mounted thereon and a dust collecting device **140** attached to the side handle **110**. The construction of the electric hammer **101** is now briefly explained with reference to FIG. **1**. The hammer **101** mainly includes a body **103** that forms an outer shell of the hammer **101**, an elongate hammer bit **119** detachably coupled to the front end region (on the left side as viewed in FIG. **1**) of the body **103** via a tool holder (not shown), and a main handle in the form of a handgrip **109** connected to the body **103** on the side opposite to the hammer bit **119** and designed to be held by a user. The body **103** and the hammer bit **119** are features that correspond to the "tool body" and the "tool bit", respectively, according to the present invention. The hammer bit **119** is held by the tool holder via a chuck **108** such that it is allowed to reciprocate with respect to the tool holder in its axial direction and prevented from rotating with respect to the tool holder in its circumferential direction. For the sake of convenience of explanation, in the hammer **101**, the side of the hammer bit **119** is taken as the front and the side of the main handle **109** as the rear.

The body **103** mainly includes a housing **105** and a generally cylindrical barrel **107** connected to the front of the housing **105**. The body **103** houses a driving motor, a motion converting mechanism in the form of a crank mechanism which converts rotation of the driving motor into linear motion, and a striking mechanism which is driven by the crank mechanism and includes a striker (striking element) for striking the hammer bit **119** in the axial direction and an impact bolt (intermediate element) for transmitting the striking movement of the striker to the hammer bit **119**.

In the hammer **101** constructed as described above, when the driving motor is driven, a striking force is applied to the hammer bit **119** in the axial direction from the crank mechanism via the striking mechanism. Thus, the hammer bit **119** performs an operation (chipping operation) on a workpiece (concrete) by a hammering movement in the axial direction.

The auxiliary handle in the form of the side handle **110** to which the dust collecting device **140** is attached is now explained with reference to FIGS. **4** and **5**. The side handle **110** is detachably mounted onto the barrel **107** of the hammer **101**. The side handle **110** mainly includes a mounting ring **111** which is mounted onto the generally cylindrical barrel **107** by holding the outer circumferential surface of the barrel **107** from the outside, a grip **121** connected to the mounting ring **111** and designed to be held by a user, and a fastening means which includes a through bolt **131** and a fastening knob **135** with a nut **133** and serves to clamp and loosen the mounting ring **111**.

The mounting ring **111** includes a pair of upper and lower generally semicircular arc ring components **113**. The pair ring components **113** are rotatably connected at one end with respect to each other via a shaft **117** which extends parallel to the longitudinal direction of the barrel **107**. An outwardly protruding base **115** is formed on the other free end of each of the ring components **113**.

The grip **121** has a rod-like shape having a generally circular section and has upper and lower arms **123** which extend in parallel to each other from the both ends of the grip **121** in the longitudinal direction (the vertical direction as viewed in FIG. **4**) toward the mounting ring **111**. The bases **115** of the mounting ring **111** are disposed between extending end portions **125** of the upper and lower arms **123** via ring-like cams **137**. The through bolt **131** is loosely inserted in the vertical direction through holes formed in the extending end portions **125**, the cams **137** and the bases **115**. The through bolt **131** has a hexagonal head **131***a* on one end, and the head **131***a* engages with an upper surface (bottom of a counterbore) of the extending end portion **125** of the upper arm **123**. The other end of the through bolt **131** protrudes a predetermined distance from the extending end portion **125** of the lower arm **123**. The nut **133** of the fastening knob **135** is threadingly engaged with a threaded portion of the through bolt **131**.

In the side handle **110** constructed as described above, when the mounting ring **111** is loosely fitted onto the barrel **107** and the fastening knob **135** is turned in one direction (tightening direction), the upper and lower extending end portions **125** are clamped (pressed) and moved (deformed), due to elasticity of the arms **123**, in a direction that lessens a distance therebetween (toward each other) by using the through bolt **131** and the fastening knob **135** (the nut **133**). As a result, the bases **115** are also moved toward each other via the upper and lower cams **137** in a direction that lessens the ring diameter of the ring components **113**. Thus, the mounting ring **111** is clamped onto the barrel **107**.

When the fastening knob **135** is turned in the other direction (loosening direction), the upper and lower extending end portions **125** and the bases **115** clamped by the through bolt **131** and the fastening knob **135** are released and return to their initial position in which they are not yet clamped, so that the mounting ring **111** us unclamped from the barrel **107**. In this state, the side handle **110** can be removed from the barrel **107**.

The dust collecting device **140** is now explained with reference to FIGS. **1** to **3**. The dust collecting device **140** is attached to the side handle **110** and serves to suck up and collect dust generated during operation on a workpiece. The dust collecting device **140** according to this embodiment mainly includes a dust collecting hood **141** for collecting dust, a dust collecting hose **146** for transferring dust downstream from the dust collecting hood **141**, and a hose holder **147** for holding the dust collecting hose **146**. The dust collecting hood **141**, the dust collecting hose **146** and the hose holder **147** are features that correspond to the "dust collecting part", the "dust transfer part" and the "hose holding part", respectively, according to the present invention.

As shown in FIGS. **2** and **3**, the dust collecting hood **141** is a generally cup-like member (generally cylindrical member with a bottom) which is arranged to surround the hammer bit **119** entirely around its axis with a predetermined clearance in the radial direction and has an internal space **141***b* with an open front end formed as a dust suction port **141***a*. On its bottom (on the side opposite from the dust suction port **141***a*), the dust collecting hood **141** has a through hole **141***c* extending in the axial direction of the hammer bit and formed for mounting a cylindrical sliding member **143** therein, and a hose connecting part **144** formed adjacent to the through hole **141***c*.

The cylindrical sliding member **143** is a guiding member for the dust collecting hood **141** and has a bore which is slidably fitted onto a shank **119***b* of the hammer bit **119**. The cylindrical sliding member **143** is detachably fitted in the through hole **141***c* of the dust collecting hood **141**. The dust suction port **141***a* of the dust collecting hood **141** is disposed at a predetermined distance away from a bit tip **119***a* of the hammer bit **119** by fitting the cylindrical sliding member **143** onto the hammer bit **119** from the front. The bore inner wall surface of the cylindrical sliding member **143** is slidably engaged with the outer surface of the shank of the hammer bit **119**. Thus, the dust collecting hood **141** is held on the shank **119***b* of the hammer bit **119**, while being allowed to move in the axial direction with respect to the hammer bit **119** via the cylindrical sliding member **143**.

The hose connecting part **144** has an open front end formed as a dust inlet into the internal space **141***b* of the dust collecting hood **141**. The hose connecting part **144** extends rearward to a predetermined length along the outer contour (tapered cylindrical shape) of the chuck **108**. The hose connecting part **144** has an open rear end formed as a dust outlet, and the dust collecting hose **146** is detachably inserted in and connected to the dust outlet. Further, a partition **145** is formed in a front end region of the hose connecting part **144** and serves to partition a passage of the hose connecting part **144** into several parts. The hose connecting part **144** is partitioned into passages **144***a* by the partition **145** such that the flow passage sectional area of each passage **144***a* is smaller than the minimum flow passage sectional area of the dust collecting hose **146**. With this construction, a large piece of dust (chip) is blocked by the partition **145** and prevented from entering the dust collecting hose **146**, so that clogging of the hose can be avoided.

As shown in FIG. **3**, the dust collecting hood **141** has a generally elliptical shape in front view (when viewed from the bit tip of the hammer bit **119**). Further, as shown in FIG. **2**, the front end region (the dust suction port **141***a* side) of the dust collecting hood **141** includes a region on a connecting part side for connection with the dust collecting hose **146** and a region on the opposite side of the hammer bit **119** from the connecting part side. The front end region of the dust collecting hood **141** is inclined such that it extends away from the bit tip **119***a* of the hammer bit **119** on the connecting part side, while extending toward the bit tip on the opposite side. Specifically, the front end region of the dust collecting hood **141** has an inclined circumferential shape on the dust suction port **141***a* side such that the region on the hose connecting part **144** side extends away from the bit tip **119***a*. With this configuration, visibility of the bit tip **119***a* (a work area of the workpiece) can be improved when it is viewed over the hose connecting part **144**, and dust sucked up into the dust collecting hood **141** can be smoothly led into the hose connecting part **144**.

The dust collecting hose **146** is a tubular member made of rubber or resin and having a bellows-like part **146***a* formed at least in part of the dust collecting hose **146**. The dust collecting hose **146** is connected to the dust collecting hood **141** by inserting one (front) end of the dust collecting hose **146** into the dust outlet of the hose connecting part **144**. The dust collecting hose **146** extends along the body **103** of the hammer **101** generally in the axial direction of the hammer bit **119** and is held on the barrel **107** via the side handle **110** by the hose holder **147**. Further, the dust collecting hose **146** is connected to a dust collector (not shown) at least during operation. In this manner, the dust collecting device **140** of this embodiment is constructed to be held on the hammer **101** at two points in the longitudinal direction such that the dust collecting hose **146** is held on the body **103** and the dust collecting hood **141** is held on the hammer bit **119**. Further, in this embodiment, the dust collecting hose **146** is connected to a dust collector formed separately from the hammer **101**, but it may be connected otherwise. For example, if the hammer **101** has a suction device including a motor and a motor-driven dust collecting fan, or if the dust collecting device itself has a suction device including a motor and a motor-driven dust collecting fan, the dust collecting hose **146** may be connected to the suction device.

As shown in FIGS. **6** and **7**, the hose holder **147** has a hose holder body **148** for holding the dust collecting hose **146** and a plate-like mounting base **149** extending from the hose holder body **148**. The hose holder body **148** is a generally circular ring-like member having a hose attachment/removal opening **148***a*. A plurality of circumferentially extending rib-like projections **148***b* are formed on an inner circumferential surface of the hose holder body **148** and can engage with valleys of the bellows-like part **146***a* of the dust collecting hose **146**. The opening width of the hose attachment/removal opening **148***a* in the circumferential direction is slightly smaller than the hose diameter. Therefore, in order to attach and remove the hose with respect to the hose holder body **148** through the opening **148***a*, the bellows-like part **146***a* is deformed into a generally elliptical form. The dust collecting hose **146** held by the hose holder body **148** is locked against axial movement by engagement between the projections **148***b* and the valleys of the bellows-like part **146***a*.

The mounting base **149** is inserted between a head **131***a* of the through bolt **131** and the upper arm **123** of the grip **121** in the side handle **110** and fastened to the side handle **110**. The mounting base **149** can be removed from the side handle **110** when the through bolt **131** is loosened. For this purpose, as shown in FIGS. **6** and **7**, the mounting base **149** has a notch **151** and a recessed engagement part **152**. The notch **151** is generally U-shaped in planar view and can be fitted onto the through bolt **131** from a radial direction. The recessed engagement part **152** is formed along a peripheral edge of an upper surface of the notch **151**, engaged with the head **131***a* of the through bolt **131** fitted in the notch **151** and locked against rotation relative to the head **131***a*. Therefore, when the through bolt **131** is loosened, the hose holder **147** can be turned about 360 degrees around the through bolt **131**, so that its position can be adjusted around the bolt axis. When the hose holder **147** is set in a predetermined position around the axis of the through bolt **131**, the through bolt **131** is tightened by turning the fastening knob **135**, the through bolt **131** which is engaged with the recessed engagement part **152** at the head **131***a* and locked against rotation is moved toward the fastening knob **135**. In this manner, the mounting base **149** is fastened to the side handle **110** between the head **131***a* of the through bolt **131** and the upper arm **123**.

The dust collecting device **140** according to this embodiment is constructed as described above. When a dust collector is driven and the hammer **101** is driven to perform a chipping operation on a workpiece by linear hammering movement of the hammer bit **119**, the dust collecting device **140** can collect dust generated during the operation. Specifically, dust generated by the hammer **101** is sucked up into the dust collecting hood **141** through the dust suction port **141***a* and collected in the dust collector via the hose connecting part **144** of the dust collecting hood **141** and the dust collecting hose **146**.

In chipping operation, hammer bits **119** of different lengths are used according to the operation conditions. In consideration of this, in this embodiment, the position of the front end of the dust collecting hood **141** (the position of the dust suction port **141***a*) can be adjusted with respect to the hammer bit **119** by changing the position in which the hose holder **147** holds the dust collecting hose **146**. Thus, the dust suction port **141***a* can be positioned at an adequate distance from the bit tip of the hammer bit **119** to be used. As a result, such a problem that the dust collecting efficiency is reduced by increase of the distance between the dust suction port **141***a* and a dust generation area can be eliminated. According to this embodiment the hammer bits **119** having different lengths can be accommodated without reducing the dust collecting ability, and a plurality of dust collecting hoods **141** are not needed.

Further, the hammer bits **119** are available in several types varying in length and in several types varying in the diameter of the shanks **119***b*. In consideration of this, in this embodiment, the cylindrical sliding member **143** is detachably fitted in the through hole **141***c* of the dust collecting hood **141**. Further, a plurality of cylindrical sliding members **143** having

bores of different diameters are provided to accommodate a plurality of hammer bits **119** having the shanks **119***b* of different diameters. Thus, the cylindrical sliding members **143** can be replaced and mounted in the through hole **141***c* of the dust collecting hood **141** in order to accommodate the hammer bits **119** having the shanks **119***b* of different diameters.

Further, in this embodiment, the dust collecting hose **146** can be attached to and removed from the hose holder body **148** through the hose attachment/removal opening **148***a,* and the dust collecting hose **146** is locked against axial movement and held by engagement between the rib-like projections **148***b* of the hose holder body **148** and the valleys of the bellows-like part **146***a* of the dust collecting hose **146**. With this construction, the front end position of the dust collecting hood **141** can be easily adjusted by changing the position of engagement of the bellows-like part **146***a* with respect to the projections **148***b* when attaching the dust collecting hose **146**. Further, with the construction in which the dust collecting hose **146** is locked against axial movement by engagement between the rib-like projections **148***b* and the valleys of the bellows-like part **146***a,* the dust collecting hood **141** can be prevented from being displaced by vibration during chipping operation so that it can be reliably and securely held in position.

Further, in this embodiment, the sleeve-like cylindrical sliding member **143** is provided on part of the dust collecting hood **141** and slidably fitted onto the shank **119***b* of the hammer bit **119**, and the dust collecting hood **141** is directly guided by the shank **119***b* of the hammer bit **119**. With this construction, the dust collecting hood **141** can be held with stability. Further, by provision of the holding stability, the dust collecting hood **141** can be placed closer to an area of dust generation, so that the dust collecting efficiency can be improved.

Further, in this embodiment, the front end region of the dust collecting hood **141** is inclined with respect to the axis of the hammer bit **119**. Therefore, when a chipping operation is performed, for example, on a vertical wall, part (the dust collecting hose connection side) of the circumferential region of the dust collecting hood **141** which extends away from the bit tip **119***a* is set to be positioned in the line of sight, or between a user's eye and a work area of the workpiece during operation, so that visibility of the work area of the workpiece can be improved when the work area is viewed over the dust collecting hood **141**. Further, part of the circumferential region of the dust collecting hood **141** which extends toward the bit tip **119***a* is placed below the hammer bit **119**. With this construction, the dust suction port **141***a* can more easily catch chips which are scattered during chipping operation.

Further, in this embodiment, the dust collecting hood **141** has a generally cup-like shape and is arranged to surround the shank **119***b* entirely around its axis at a distance away from the bit tip **119***a* of the hammer bit **119**. With this construction, the dust collecting hood **141** can be made smaller, and visibility of the work area can be improved.

(Second Embodiment of the Invention)

A dust collecting device according to a second embodiment of the present invention is now described with reference to FIGS. **8** to **10**. The second embodiment is a modification to the hose holder **147**, which is described in the first embodiment, for holding the dust collecting hose **146** in the dust collecting device. The entire construction of the dust collecting device **140** other than the hose holder is the same as in the first embodiment. A hose holder **161** of this embodiment mainly includes an annular hose holder body **162** which serves to hold the dust collecting hose **146** and through which the dust collecting hose **146** can be inserted, a plate-like mounting base **163** extending from the hose holder body **162**, and a semicircular arc locking member **164** for locking the dust collecting hose **146** to the hose holder body **162**. The hose holder **161** is a feature that corresponds to the "hose holding part" according to this invention, and the hose holder body **162** and the locking member **164** are features that correspond to the "annular member" and the "engagement member", respectively, according to claim **4** of this invention.

The hose holder body **162** is a circular ring-like member having an inner diameter slightly larger than the outer diameter of the bellows-like part **146***a* of the dust collecting hose **146**. The hose holder body **162** has an opening **162***a* (see FIG. **10**) formed in the middle in its axial direction and extending over a predetermined area (of about 180 degrees) in the circumferential direction. The locking member **164** has a generally semicircular arc shape having about the same radius of curvature as the inner diameter of the hose holder body **162**, and is disposed in the opening **162***a* of the hose holder body **162**. One end of the locking member **164** is rotatably connected to the hose holder body **162** by a pin **165**. At the other end, the locking member **164** has a protruding end **164***a* protruding radially outward of the hose holder body **162**. The protruding end **164***a* faces an upper surface of the mounting base **163**. One or more locking projections **164***b* are formed on the inner surface of the locking member **164** and protrude radially inward. The locking projections **164***b* are engaged with the valleys of the bellows-like part **146***a* of the dust collecting hose **146** so that the dust collecting hose **146** is locked against axial movement with respect to the hose bolder body **162**. This state is shown in FIG. **8**.

A compression coil spring **166** is disposed between the mounting base **163** and the protruding end **164***a* which face each other. Thus, the locking member **164** is biased to turn radially inward such that the locking projections **164***b* are engaged with the valleys of the bellows-like part **146***a* of the dust collecting hose **146**. Therefore, the locking projections **164***b* and the valleys of the bellows-like part **146***a* are held in engagement and the dust collecting hose **146** is locked against axial movement. The compression coil spring **166** is a feature that corresponds to the "biasing member" according to this invention. The locking member **164** has a stopper **164***c* for defining the limit to which the locking member **164** can be turned radially inward by the compression coil spring **166**. The stopper **164***c* is formed as a projection extending in the axial direction on the outer circumferential surface of the locking member **164**. When the locking member **164** is turned radially inward, the stopper **164***c* comes into contact with the outer surface of the hose holder body **162** and prevents the locking member **164** from being further turned.

Further, the protruding end **164***a* of the locking member **164** forms an operation knob. When the protruding end **164***a* is pressed against the biasing force of the compression coil spring **166**, the locking member **164** is turned radially outward on the pin **165**. Thus, the locking projections **164***b* are disengaged from the bellows-like part **146***a,* so that the dust collecting hose **146** is allowed to move in the axial direction. This state is shown in FIG. **9**.

According to this embodiment constructed as described above, after the protruding end **164***a* of the locking member **164** is pressed and the locking projections **164***b* are disengaged from the bellows-like part **146***a* of the dust collecting hose **146**, the position of the front end of the dust collecting hood **141** can be adjusted with respect to the hammer bit **119** by moving the dust collecting hose **146** in the axial direction. Once the dust collecting hood **141** is positioned, engagement between the bellows-like part **146***a* and the locking projections **164***b* is maintained by the compression coil spring **166**.

Therefore, there exists no risk that the dust collecting hood **141** is unintentionally displaced due to vibration caused by the operation.

(Third Embodiment of the Invention)

A dust collecting device **170** according to a third embodiment of the present invention is now described with reference to FIGS. **11** to **13**. As shown in FIG. **11**, the dust collecting device **170** according to this embodiment mainly includes a generally cylindrical mounting part **171** made of synthetic resin and having open ends in the axial direction, and a generally cylindrical, telescopic dust collecting hood **173** having open ends in the axial direction. The dust collecting hood **173** is connected to one (front) end of the cylindrical mounting part **171** and formed telescopically in the axial direction of the hammer bit **119**. The cylindrical mounting part **171** of the dust collecting device **170** is fitted over the front end region of the barrel **107** from the front, and removably mounted together with the side handle **210** on a handle mounting part formed on the outer surface of the front end portion of the barrel **107**. The telescopic dust collecting hood **173** is a feature that corresponds to the "bit covering" according to this invention.

In order to mount the side handle **210** (partly shown in FIG. **11**) of this embodiment, a band **211** is put around the outer surface of the handle mounting part and tightened by a screw. The dust collecting device **170** is constructed such that the cylindrical mounting part **171** is mounted together with the side handle **210** by the belt **211** when the side handle **210** is mounted on the handle mounting part of the barrel **107**. This mounting structure is not directly related to this invention, and therefore its description is omitted here.

The telescopic dust collecting hood **173** of the dust collecting device **170** has a double-cylinder structure having two cylindrical hoods **173***a*, **173***b* which are slidably connected (fitted) to each other in the axial direction. The two hoods **173***a*, **173***b* are features that correspond to the "plurality of cylindrical members" according to this invention. As shown in FIGS. **12** and **13**, the front hood **173***a* is fitted on the outer surface of the hood **173***b* on the barrel **107** side. A female thread **174***a* is formed in the inner surface of the front hood **173***a* over a predetermined region in the axial direction, and a projection (male thread) **174***a* is formed on the outer surface of the hood **173***b* on the barrel **107** side along almost the entire length in the axial direction and engages with the female thread **174***a*. The projection **174***b* is a feature that corresponds to the "engagement projection" according to this invention. Specifically, the two hoods **173***a*, **173***b* are moved relative to each other by thread engagement between the female thread **174***a* and the projection **174***b*. The front end position of the front hood **173***a* can be adjusted steplessly with respect to the bit tip **119***a* of the hammer bit **119** by turning the front hood **173***a* clockwise or counterclockwise with respect to the barrel-side hood **173***b*. A front opening of the front hood **173***a* forms a dust suction port **172**. FIG. **12** shows the telescopic dust collecting hood **173** set in a fully extended position by moving the front hood **173***a* forward, and FIG. **13** shows the dust collecting hood **173** set in a fully retracted position by moving the front hood **173***a* rearward. The barrel side hood **173***b* is removably fitted at its rear end onto a front end of the cylindrical mounting part **171**.

A hose connecting part **175** is formed on the cylindrical mounting part **171** in the vicinity of a connection between the mounting part **171** and the telescopic dust collecting hood **173**. A dust collecting hose **176** for transferring dust to a dust collector is removably connected to the hose connecting part **175**. Thus, dust generated during chipping operation is sucked up through the dust suction port **172** of the front hood **173***a*, and collected in the dust collector via the internal space of the telescopic dust collecting hood **173** and the dust collecting hose **176**.

In the dust collecting device **170** constructed as described above according to this embodiment, the position of the front hood **173***a* of the dust collecting device **170** can be adjusted by turning the front hood **173***a* of the telescopic dust collecting hood **173**. Therefore, like in the first embodiment, the hammer bits **119** having different lengths can be accommodated without reducing the dust collecting ability. Further, due to stepless position adjustment by using the threads, an adequate position of the hood with respect to the bit tip **119***a* can be easily obtained.

Further, in this embodiment, the female thread **174***a* is formed over the entire circumference of the inner surface of the end region of the front hood **173***a* for connection with the barrel side hood **173***b*, and the projection **174***b* is formed on part of the outer surface of the barrel side hood **173***b* in the circumferential direction and along the entire length in the axial direction. With this construction, the threaded area can be reduced, so that the manufacturing costs can be reduced. Further, the above-described arrangement of the threads can be provided vice versa. Specifically, the projection **174***b* may be formed on the area for the female thread **174***a*, and the female thread **174** may be formed in the area for the projection **174***a*.

Now, a modification to the telescopic dust collecting hood **173** of the dust collecting device **170** according to the third embodiment is described with reference to FIGS. **14** to **16**. In this modification, the front hood **173***a* of the telescopic dust collecting hood **173** is fitted on the barrel side hood **173***b*. The front hood **173***a* has projections **177***a*, and the barrel side hood **173***b* has recesses **177***b* which can be engaged with the projections **177***a*. Relative movement of the hoods **173***a*, **173***b* in the axial direction is prevented by engagement between the projections **177***a* and the recesses **177***b*, while it is allowed by disengagement therebetween. Engagement and disengagement between the projections **177***a* and the recesses **177***b* are effected by turning the front hood **173***a* around its axis with respect to the barrel side hood **173***b*. FIGS. **14** and **15** show the projections **177***a* and the recesses **177***b* in the engaged position, and FIG. **16** shows them in the disengaged position. In this disengaged position, the position of the hood front end can be adjusted.

A slit **178** is formed in the barrel side hood **173***b* in the axial direction, and the recesses **177***b* are formed in one edge of the slit **178** along almost the entire length. The recesses **177***b* have a generally semicircular, U-shaped or V-shaped form which is open into the slit **178** and are arranged in series at predetermined intervals. The projections **177***a* are formed on the inner surface of an end region of the front hood **173***a* for connection with the barrel side hood **173***b* and have a semispherical or cylindrical form protruding inward. The projections **177***a* are placed in the slit **178** of the barrel side hood **173***b*. Therefore, the slit **178** has a width large enough to allow movement of the projections **177***a* in the axial direction. Further, although, in this embodiment, the slit **178** and the recesses **177***b* are formed in the barrel side hood **173***b* and the projections **177***a* are formed in the front hood **173***a*, the projections **177***a* may be formed in the barrel side hood **173***b* and the slit **178** and the recesses **177***b* may be formed in the front hood **173***a*.

This modification is constructed as described above, and in the other points, it has the same construction as the dust collecting device **170** of the third embodiment shown in FIGS. **11** to **13**. According to this modification, in the dust collecting device **170** having the telescopic dust collecting

hood **173**, multistep adjustment of the position of the front end of the front hood **173***a* or the position of the dust suction port **172** with respect to the bit tip **119***a* of the hammer bit **119** can be realized by engagement between the projections **177***a* and the recesses **177***b*. Therefore, like in the third embodiment, the hammer bits **119** having different lengths can be accommodated without reducing the dust collecting ability.

Next, another modification to the telescopic dust collecting hood **173** of the dust collecting device **170** according to the third embodiment is described with reference to FIGS. **17** to **19**. In this modification, the telescopic dust collecting hood **173** includes at least three hoods, or a front hood **173***a*, a barrel side hood **173***b* and an intermediate hood **173***c*. The front hood **173***a* is fitted on the intermediate hood **173***c*, and the intermediate hood **173***c* is fitted on the barrel side hood **173***b*. The three hoods **173***a*, **173***b*, **173***c* can be telescopically slid with respect to each other in the axial direction.

As shown in an enlarged partial view of FIG. **19**, a circumferentially extending annular recess **179***b* is formed in a front end region of the outer surface of each of the barrel side hood **173***b* and the intermediate hood **173***c*. A plurality of (three in this embodiment) annular projections **179***a* are formed for engagement with the recess **179***b* on the inner surface of each of the intermediate hood **173***c* and the front hood **173***a* at predetermined intervals in the axial direction. When the front hood **173***a* is slid with respect to the intermediate hood **173***c* in the axial direction, any one of the projections **179***a* of the front hood **173***a* is engaged with the recess **179***b* of the intermediate hood **173***c*. Similarly, when the intermediate hood **173***c* is slid with respect to the barrel side hood **173***b* in the axial direction, any one of the projections **179***a* of the intermediate hood **173***c* is engaged with the recess **179***b* of the barrel side hood **173***b*.

In this embodiment, the positions of the front hood **173***a* and the intermediate hood **173***c* can be adjusted in the axial direction in the same multiple number of steps as the number of their respective projections **179***a* (three steps each). Each of the front hood **173***a* and the intermediate hood **173***c* is held in an adjusted position in which the projection **179***a* is engaged with the recess **179***b*. The projections **179***a* and the recesses **179***b* are engaged and disengaged by elastic deformation of the hoods **173***a*, **173***b*, **173***c*.

Each of the intermediate hood **173***c* and the barrel side hood **173***b* has a hood front end region **181***a* having the recess **179***b*. The hood front end region **181***a* has a diameter larger than the other region of the hood, so that the projections **179***a* can be avoided from interfering with the region other than the hood front end region **181***a* when passing therethrough. Further, a sliding region **181***b* is formed on a body side end of the front hood **173***a* and held in sliding contact with the outer surface of the intermediate hood **173***c*. A sliding region **181***c* is formed on a body side end of the intermediate hood **173***c* and held in sliding contact with the outer surface of the barrel side hood **173***b*. By provision of the sliding regions **181***b*, **181***c*, the front hood **173***a* and the intermediate hood **173***c* can be moved with stability in the axial direction.

This modification is constructed as described above, and in the other points, it has the same construction as the dust collecting device **170** of the third embodiment shown in FIGS. **11** to **13**.

According to this modification, in the dust collecting device **170** having the telescopic dust collecting hood **173**, multistep adjustment of the position of the front end of the front hood **173***a* or the position of the dust suction port **172** with respect to the bit tip **119***a* of the hammer bit **119** can be realized by engagement between the projections **179***a* and the recesses **179***b*. Therefore, like in the third embodiment, the hammer bits **119** having different lengths can be accommodated without reducing the dust collecting ability.

Further, in the above-described embodiments, the electric hammer in which the hammer bit **119** performs only hammering movement in the axial direction is explained as a representative example of the impact tool according to the present invention, but the present invention can also be applied to a hammer drill which can switch between hammering mode in which the hammer bit **119** performs hammering movement and hammer drill mode in which it performs hammering movement in the axial direction and hammer drill movement in the circumferential direction.

In view of the scope and spirit of the above-described invention, the following features can be provided.

(1)

"A dust collecting device that is attached to an impact tool and collects dust generated by the impact tool in which a tool bit coupled to a front end region of a tool body is caused to rectilinearly move in an axial direction of the tool bit, comprising:

a dust suction port through which dust is sucked up and which can be adjusted in position in the axial direction of the tool bit according to a length of the tool bit in the axial direction, so that the tool bits having different lengths can be accommodated without reducing the dust collecting ability."

DESCRIPTION OF NUMERALS

101 electric hammer (impact tool)
103 body
105 housing
107 barrel
108 chuck
109 handgrip (main handle)
110 side handle
111 mounting ring
113 ring component
115 base
117 shall
119 hammer bit (tool bit)
119*a* bit tip
119*b* shank
121 grip
123 arm
125 extending end portion
131 through bolt
131*a* head
133 nut
135 listening knob
137 cam
140 dust collecting device
141 dust collecting hood (dust collecting part)
141*a* dust suction, port
141*b* internal space
141*c* through hole
143 cylindrical sliding member
144 hose connecting part
144*a* passage
145 partition
146 dust collecting hose (dust transfer part)
146*a* bellows-like part
147 hose holder (hose holding part)
148 hose holder body
148*a* hose attachment/removal opening
148*b* projection
149 mounting base
151 notch

152 recessed engagement part
161 hose holder (hose holding part)
162 hose holder body
162*a* opening
163 mounting base
164 locking member
164*a* protruding end (operating part)
164*b* locking projection (engagement member)
164*c* stopper
165 pin
166 compression coil spring
170 dust collecting device
171 cylindrical mounting part
172 dust suction port
173 telescopic dust collecting hood (bit covering)
173*a* front hood
173*b* barrel side hood
173*c* intermediate hood
174*a* female thread
174*b* projection (engagement projection)
175 hose connecting part
176 dust collecting hose
177*a* projection
177*b* recess
178 slit
179*a* projection
179*b* recess
181*a* hood front end region
181*b* sliding region
181*c* sliding region

The invention claimed is:

1. A dust collecting device that is attached to an impact tool and collects dust generated by the impact tool in which a tool bit coupled to a front end region of a tool body is caused to rectilinearly move in an axial direction of the tool bit, comprising:

a dust suction port through which dust is sucked up and which can be adjusted in position in the axial direction of the tool bit according to a length of the tool bit in the axial direction,

a dust collecting part having the dust suction port at its front end,

a dust transfer part which is connected to the dust collecting part in order to transfer dust downstream from the dust suction port, the dust transfer part comprising a dust collecting hose which extends in the axial direction of the toll bit and has a bellow-like part formed at least in part of the dust collecting hose, and

a hose holding part which can be mounted to the tool body and engaged with the bellow-like part so as to hold the dust collecting hose on the tool body,

wherein the position of the dust suction part in the axial direction of the tool bit can be adjusted by changing as engagement position of the bellow-like part in an axial direction with respect to the hose holding part.

2. The dust collecting device as defined in claim **1**, wherein the hose holding part includes an annular member through which the dust collecting hose is loosely inserted, an engagement member which is formed on the annular member and can be engaged with the bellows-like part, and a biasing member which constantly biases the engagement member in a direction in which the engagement member is engaged with the bellows-like part, and wherein the engagement member can be moved in a radial direction of the annular member between a position of engagement with the bellows-like part and a position of disengagement from the bellows-like part.

3. An impact tool having the dust collecting device as defined in claim **1**.

4. A dust collecting device that is attached to an impact tool and collect dust generated by the impact toll in which a tool bit coupled to a front end region of a tool body is caused to rectilinearly move in a axial direction of the tool bit, comprising:

a dust suction port through which dust is sucked up and which can be adjusted in position in the axial direction of the tool bit according to a length of the tool bit in the axial direction,

a bit covering which is arranged to surround the tool bit and has the dust suction port formed at its front end,

wherein the bit covering comprises a plurality of cylindrical members which are fitted one on the other and can be moved relative to each other in the axial direction of the tool bit, and the position of the dust suction port can be adjusted by relative movement of the cylindrical members, and

the plurality of cylindrical members are configured to be moved relative to each other thereby adjusting the position of the dust suction port in the axial direction of the tool bit and also configured to maintain the adjusted position of the dust suction port during a processing operation after the position adjustment.

5. The dust collecting device as defined in claim **4**, wherein a female thread is formed in one of the cylindrical members and an engagement projection is formed on the other and engages with the female thread, and when turned relative to each other in the circumferential direction, the cylindrical members can be moved relative to each other in the axial direction by engagement between the female thread and the engagement projection.

6. The dust collecting device as defined in claim **4**, wherein the cylindrical members can be moved relative to each other in the axial direction and the circumferential direction, and one of the cylindrical members has a recess and the other has a projection which can be engaged with and disengaged from the recess by relative movement of the cylindrical members in the circumferential direction, and wherein at least one of the recess and the projection is arranged in plurality in the axial direction of the cylindrical members.

7. The dust collecting device as defined in claim **4**, wherein the cylindrical members can be telescopically slid with respect to each other in the axial direction, and a projection is formed on one of a sliding inner surface of one cylindrical member and a sliding outer surface on the other adjacent cylindrical member, and a recess is formed in the other of the sliding inner surface and the sliding outer surface and can be engaged with and disengaged from the projection by elastic deformation, and wherein the adjacent cylindrical members are held in the engaged position by engagement between the projection and the recess.

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